Puzzle Project Design Challenge – TED

Introduction:

Have you ever looked at a product that has been well-designed? Do you find yourself asking questions such as, “How did the designer think of that idea?” or “What is involved in the creation of that product?” The more you study and learn about design and how designers create items, you begin to learn certain skills and knowledge that you can only acquire through experience. Design challenges provide opportunities to apply skills and knowledge in unique and creative ways.

Taking an idea you have and transferring it from a concept to a sketch, to working drawings, to models, and then to a working prototype is exciting and fun. It also entails several steps. When you are a one-person design and build team, the task of effective communication is rather simple. However, what happens when you must communicate your ideas to others, or when the responsibility for building a team’s solution falls on someone else’s shoulders? This increases the level of responsibility significantly and requires the development of a complete set of design documentation in order to communicate effectively.

This project will provide you the opportunity to exercise your creativity and develop your sketching and modeling skills, as well as your ability to use the computer as an efficient communication tool.

Equipment:

- Engineering notebook
- Pencil
- 27 – interlocking plastic cubes
- Isometric grid paper
- Orthographic grid paper
- Color pencils
- Computer with 3D CAD solid modeling software

Puzzle Design Challenge Brief

Client	**Fine Office Furniture, Inc.**
Target Consumer	**Ages: High school aged**
Designer	_____

Problem Statement

A local office furniture manufacturing company throws away tens of thousands of scrap ½ ” hardwood cubes that result from its furniture construction processes. The material is expensive, and the scrap represents a sizable loss of profit.

Design Statement

Fine Office Furniture, Inc. would like to return value to its waste product by using it as the raw material for desktop novelty items that will be sold on the showroom floor. Design, build, test, document, and present a three-dimensional puzzle system that is made from the scrap hardwood cubes. The puzzle system must provide an appropriate degree of challenge to high school students.

Criteria

- The puzzle system must contain exactly five (5) puzzle parts.
- Each individual puzzle part must consist of at least four, but no more than six hardwood cubes that are permanently attached to each other.
- No two puzzle parts can be the same.
- Some puzzle parts should interlock.

Submittal

Create a project portfolio page on your website to include the following Engineering Design Process Documentation:

- Design Process Description. Summarize your work during each step of the design process. Include documentation (written work, sketches, CAD drawings, images, etc.) to support your discussion. Your documentation must include the following information located in the appropriate Design Process step:
    - Title
    - Brainstorming Possible Part Combinations (Activity 1a Puzzle Part Combinations)
    - Isometric sketches of two possible complete Puzzle Cube designs
    - Justification of your chosen Puzzle Cube design solution
    - Multi-view sketch, fully dimensioned of each of the five puzzle parts in your chosen design
    - CAD drawing(s) displaying a fully dimensioned multi-view of each puzzle part and two different isometric views of the assembled puzzle.
    - Drawing review comments from a classmate.
    - Physical model of your puzzle.
    - Statistics related to the solution time of your puzzle as required above.
    - A written summary of your puzzle test results and a discussion of the validity of your design. Does your design meet the design criteria? Does your design "provide an appropriate degree of challenge to high school students" (as stated in the design statement)?
    - A discussion of possible changes to your puzzle cube that would improve the design.

1a Puzzle Cube Combinations

Introduction

Have you ever looked at a series of letters and been asked to come up with as many words as possible out of the list of letters? Have you ever looked at a series of numbers and been asked to figure out what code, sequence, or combination would result from the number series? Designers try to exhaust all possible combinations or solutions to an existing problem until the most intuitive solution comes along. Brainstorming several times throughout a project is very common when designing new products.

Equipment

- Pencil
- Isometric Grid Paper
- Engineering notebook
- Six wooden cube blocks

Procedure

In this activity you will be given six ½ in. wooden cubes. You will brainstorm as many part combinations as possible using only three of those cubes. You will sketch your part combinations on the isometric grid paper provided. Make sure that you date and sign each combination that you document. You will perform the same process using just four cubes, then with five cubes, and finally with six cubes. It is important that you identify as many combinations as possible for each set of cubes. The goal is to come up with more combinations than your classmates.

Your sketches will be used to help you determine what parts you would want for your cube and how they would fit together.

You will present your findings to the teacher for review.

1b Engineering Graphics

Introduction

Technical drawings are used by engineers to graphically communicate engineering designs to those who will analyze or build the product or system. In order that the drawings are interpreted correctly by all stakeholders, the drawings are created using a graphical language based on accepted standard practice and should include all information necessary to correctly manufacture and/or assemble the product. In the past technical drawings were created by hand; however, today technical drawings can be created using computer software or generated by 3D solid modeling programs. However, even with the available computer technology, designers still use hand drawn representations to convey design ideas and details, especially in the beginning phases of the design process.

In this activity you will document alternate designs with pictorial sketches and specify your final puzzle cube design by creating a multi-view drawing for each piece.

Equipment

- Orthographic grid paper
- Isometric grid paper (optional)
- Pencil
- Computer with Internet access

Procedure

1. Using the puzzle part options that you generated during Activity 1a Puzzle Cube Combinations, create **two** different puzzle cube designs. One design should be relatively easy to solve and the other more difficult. You will need a total of **two** solutions with ten unique parts. Note that, in general, more interlocking pieces make a puzzle cube more difficult to solve.

2. For each design, neatly sketch and color code an isometric view of each of the five component parts and show how they fit together in the isometric view of the cube. See your teacher for an example.

3. Choose the best design from the two options. Document the reasons for your choice in your engineering notebook.

4. On orthographic grid paper, create a multi-view drawing of each of your five puzzle pieces for the selected design. Carefully select the best front view and include all objects and hidden lines. Show the minimum number of orthographic projections necessary to fully detail the part. Do NOT show the joints between individual wooden cubes.